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TRANSPORTATION CONTROL STRATEGY FOR THE DAYTON METROPOLITAN AREA

Fred Winkler

TRW Transportation and Environmental Operations

Prepared for:

Environmental Protection Agency

December 1972

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16. Abstracts

The document demonstrates the nature of the Air Quality problem attributed to motor vehicle operation, the magnitude of the problem and a strategy developed to neutralize these effects in order that National Ambient air quality standard may be attained and maintained.

17. Key Words and Document Analysis. 17a. Descriptors

Motor Vehicle emitted pollutants - air pollutants originating within a motor vehicle and released to the atmosphere.

National Ambient Air Quality Standards - Air Quality Standards promulgated by the Environmental Protection Agency and published as a Federal Regulation in the Federal Register.

17b. Identifiers/Open-Ended Terms

VMT - Vehicle Miles Traveled
Vehicle Mix - distribution of motor vehicle population by age group.
LDV - light duty vehicle - less than 6500 lbs.
HDV - heavy duty vehicle - greater than 6500 lbs.

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1.0 SUMMARY

1.1 AIR QUALITY

The second highest measurement of oxidant concentration during 1971 was 343 micrograms per cubic meter, 1 hour reading[1]. It was measured at the sole monitor operating at that time (just off Dixie Drive, approximately five miles north of town). The national primary standard of 160 micrograms per cubic meter, 1 hour reading, must be achieved by July, 1977. Carbon monoxide measurements indicate that no problem should exist with carbon monoxide ambient air levels by July, 1977.

1.2 EMISSION REDUCTION REQUIRED

A reduction of 58 percent in hydrocarbon emissions is estimated to be needed to achieve the oxidant National Ambient Air Quality Standard, assuming the air quality data to be accurate and representative[2].

Table 1-1 shows the stationary, mobile, and total hydrocarbon emissions for 1971, 1977 with only federal emission controls applied, and 1977 as required to meet the National Ambient Air Quality Standard (58 percent reduction in total emissions). Comparison of the two 1977 columns indicates that an additional 27.2 percent reduction in mobile emissions will be required to achieve the necessary 16.2 percent required reduction in total emissions.

The above is based on available air quality and emission inventory data. Of immediate concern should be the review and revision (if necessary) of stationary source data, associated growth and control factors, and the requirement for a more comprehensive monitoring network. Should the revised data confirm the necessity for them, the following control measures will be effective in reducing mobile source emissions.

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(1) Data supplied by Montgomery County Health Department.

(2) Federal Register, Vol. 36, No. 228, Thursday, November 25, 1971. P22413, Figure 1.

TABLE 1-1

24-HOUR HYDROCARBON EMISSIONS FOR
MONTGOMERY AND GREENE COUNTIES (kg/day)

	1971	1977 (Federal)	1978 (Federal)	1977 (Standard)
Stationary	61,224	29,902	31,009	29,902
Mobile*	86,693	44,251	38,655	32,223
Total	147,917	74,153	69,664	62,125

*Based on average speed of 28.0 mph for 1971 and 29.1 mph for 1977, 78.

1.3 CONTROL MEASURES

Control measures which can be used to reduce mobile source emissions and their estimated effects are as follows:

- CBD priority - give priority to those control measures which preferencially control emissions from the CBD.
- Inspection & maintenance - one of the several inspection alternatives are needed to maintain engine performance and emission controls at lower emission levels. Estimated reduction is 12 percent of the hydrocarbon emissions.
- Curb side parking and loading regulations - promulgate and enforce regulations to restrict curb side parking and extended loading times. Estimated reduction 1-3 percent.
- Gaseous fuels - conversion of certain fleet vehicles (taxis, police, etc.) to gaseous fuels would result in an estimated reduction of less than 1 percent.
- Increased Mass Transportation Ridership - control measures which have the potential for increasing ridership are as follows:

  - Revised Management/Administration of Transit System
  - Route and Schedule Improvements
  - Reduced Fares for Frequent Riders, Senior Citizens and Students
  - Better Marketing Program
  - Replacement of Outdated Equipment
  - Provision of Bus Shelters and Benches
  - Extension of Routes to Unserved Areas
  - Park and Ride Facilities

  Ridership increases from 1 to 20 percent are estimated to reduce emissions less than 1 percent.

- Restraints - restraints with prohibition for certain classes of vehicles from congested areas and parking space control for inhibiting the movement of vehicles into areas where limited parking is available.

- Vehicle Miles Traveled Controls - the responsible planning agency should factor air quality effects into their transportation planning.
- Modified Work Schedules and Four Day Work Weeks - the staggering of working hours would tend to spread total emissions over a longer period of time thus reducing the peak concentrations of pollutants. The estimated reduction would be up to 3 percent.
- Episode Controls - temporary measures instituted on an as-required basis. Examples would be: restricted use of private automobiles (by area, number of passengers, etc.), controls on stationary sources, or other appropriate methods. Emission reductions would be dependent upon severity of controls.

1.3.1 Data Base

The present air quality and transportation data base is inadequate to accurately project control measure effects on emission reduction and air quality. Control strategy implementation should include the collection of adequate data, and the strategy should be flexible enough to respond to updated projecttions of required emission reduction.

1.3.2 Limitations Of The Transportation Control Strategy Analysis

The basic requirement which any acceptable air pollution control strategy must meet is that emission levels following implementation of the strategy are consistent with the attainment and maintenance of National Ambient Air Quality Standards. Satisfaction of this requirement depends upon a detailed knowledge of current air quality levels and a quantification of the pollutant emissions in the region. Additionally, an implementable transportation control strategy must consider the economic factors associated with its adoption and also the social and political changes necessary to accommodate each specific control measure. The air quality benefits of any action must be thus balanced against the social and economic dislocations caused by its implementation. Long-term regional transportation goals and policies must be balanced against the need to achieve specific degrees of emission reduction by 1977. Limitations in the data available and in the analytic method used became obvious during the course of this study, and

care must be taken in the interpretation and evaluation of the control strategy recommendations contained in this report. Several specific areas in which the present study needs to be confirmed and validated by future study are listed below.

Air Quality Monitoring

Two basic areas of concern appear in connection with air quality data available for this project. First and most important, ambient monitoring at only one point completely fails to give an adequate appreciation of the regional character of the air pollution problem. It is impossible to determine whether the monitor is being adversely affected by local sources and thus giving an unrealistically high reading in terms of the regional problem or conversely, whether there are areas of maximum ambient pollution that are being completely unmonitored. The only solution to this problem lies in increasing the number and geographical spread of ambient monitors. Data from the extended monitoring network should be used to constantly evaluate and update the control strategy presented in this document. The second problem concerning the use of air quality monitoring data lies in the statistical manipulations and projections used to determine the required level of reduction for the attainment of standards. Basing an extensive control program on measurements obtained in one or two hours per year may lead to the imposition of unduly strict control measures. The trend of ambient measurements during the period before the target year of 1977 must be carefully watched and used to adjust control measures according to observed ambient conditions. Further, specific high measurements obviously due to adverse meteorological conditions may be considered as episode control situations and may not require the imposition of long-term transportation control strategies for their solution.

Emission Factors

The mobile source emission estimates utilized in this study are based upon the best currently available emission factor estimates. These emission estimates are in the process of being updated and revised with both in-use and new vehicle testing programs, conducted by the Environmental

Protection Agency. The applicability of the standard test driving cycle to the driving patterns in each metropolitan area is questionable. Further, there are many trip types making up the total vehicle miles traveled in each area; and it has not been possible on the basis of currently available data to distinguish in an air pollution emissions sense between the different driving modes used. It is highly recommended that new emission factors be utilized as they become available to recompute and redefine the severity of the mobile source generated emission in the region. Finally, the emission factors used in the study relate speed to the emission only on the basis of the integrated driving cycle. This has prevented the accurate assessment of changes in emissions due to improvement in traffic flow characteristics in core, center city areas.

Cold Start Emissions

Preliminary data have shown that the emissions generated during the first few minutes of vehicle operations represent a large and increasing portion of the total emissions during any individual vehicle trip. The implications of this fact are that to truly reduce mobile source emissions it may be necessary to address the reduction in total vehicle trips rather than merely reducing the number of vehicles miles traveled. Unfortunately, the data relating to this phenomena were not sufficiently developed to be used in the analysis presented in this study. Another potential effect of control strategy to reduce high level cold start emissions might be the control as a stationary source of parking structures. Again, it has not been possible to quantitatively describe the effect of this type measure on the regional air pollution problem in this report.

Traffic Data and Projections

Traffic data and traffic projections have not historically been collected with a view to the estimation of motor vehicle air pollution emissions. In addition, travel forecasts from the most recent transportation study (1968) are not available. This fact has necessitated the reworking of traffic data including vehicle flows, speeds and modal mixes into the format necessary for emission calculations. Certain assumptions and potential inaccuracies have been introducted by this process. Further, trends and projections in

vehicle growth have been prepared by various agencies and often little unanimity has been found concerning appropriate growth rates. These data in certain cases require that a close watch be maintained both on traffic changes and ambient air quality during the period between now and full strategy implementation so that any deviations from the expected vehicle emission rates can be determined and appropriate adjustments made in the control strategy. It should be noted that stationary source emission projections also suffer from inaccuracies in the projection of industrial growth and in the application of as yet untested control technologies to control of these stationary sources.

Analytic Techniques Used

The key analytic calculation performed in this study is the relation between emission levels and ambient air quality. Due to the time restraints it was not possible to utilize sophisticated mathematical modeling techniques in the development of this relation between emissions and air quality. Control strategy reductions were thus based on proportional rollback techniques relating existing emissions and air quality on a proportional basis. The use of modeling is highly recommended since it will both include the effects of local meteorological and topographical features and indicate, in a way that rollback estimation cannot, the geographical extent of the regional air pollution problem. Such modeling and simulation exercises using models currently under development should be carried out during the years between now and 1977 and should be used to modify, if required, the control strategy recommended in this document.

Effects of Control Measures

It was generally not possible to expressly quantify the emission reduction effect of many of the control measures considered in this document. For example, the effect of the inspection and maintenance program depends strongly upon the exact test procedure used, maintenance recommendations, the quality and availability of trained mechanics and a host of other factors which were impossible to define exactly during this study. Similarly, mass transit improvements can be expected to reduce vehicle miles traveled within the region. The extent of this reduction is unknown until specific data

concerning the economic elasticity of the various travel demands, the modal split of trips within the region, and many other factors are carefully evaluated.

It is strongly recommended that programs be instituted to provide additional data and apply more sophisticated analytic techniques in the areas listed above. Work must begin on the implementation of the required regional control measures; however, final implementation and enforcement should be dependent upon data collected during calendar years 1973, 1974, and even 1975. Full consideration must be given to the political, jurisdictional and social impact of all control actions. The control strategy presented in this document must be considered as an initial attempt to quantify the relationship between transportation processes and the regional air pollution problem. The further study indicated should be used to modify this baseline effort. The air pollution implications of the transportation process are very complex and a modification of this process can potentially effect significant changes in the social and economic character of the metropolitan region.

2.0 CONCLUSIONS AND RECOMMENDATIONS

The indicated required emission reduction is not necessarily a valid figure. Serious doubt exists about the validity of the data used to determine the air quality for the Dayton area. Reasons for this doubt are based on the erratic nature of peak value (372 micrograms per cubic meter) obtained on only one day in well over a year of monitoring, and upon the fact that neither this value nor any value close to it has been repeated since August 1971. During the equivalent period of 1972 no value of the same order of magnitude was obtained. Perhaps the most important factor in questioning the validity of the 1971 summer data is the location of the monitor in relation to abnormal traffic flow patterns during that time. At the time when the high readings were obtained a temporary interchange was located at the interstate highway approximately one mile east of the monitor. Traffic was diverted to a road upwind of the monitor across to Dixie highway, located to the west of the monitor approximately 200 to 300 yards. It might be noted that during this time when the high oxidant readings were obtained, the carbon monoxide monitor in the CBD did not have a correspondingly high peak. This would indicate that the emissions in the CBD were not in proportion to the unusually high value measured at the monitor located 4 to 5 miles north of town. In addition, the monitor is located in a parking lot used by the school district for parking school buses. Although these buses should not normally create a problem with photochemical oxidants due to the lag time in oxidant formation after emission of hydrocarbons and oxides of nitrogen, the buses could have been involved in the especially high reading that was recorded on August 30 due to excessive NO_2 interference which may not have been accounted for by usual statistical adjustment procedures.

It should be noted that the temporary interchange has since been closed and the interstate highway opened to traffic. During the summer of 1972 no value approached the single value measured on August 30, 1971, of 372 micrograms per cubic meter, and in fact no value approached that level again after August 30, 1971. The second highest reading was measured the hour after the highest reading on August 30, and that value was 343 micrograms per cubic meter. The next highest value measured was on August 30, 1971

(314 micrograms per cubic meter). The highest value measured during the summer months of 1972 and in fact the highest value measured since September of 1971 was 225 micrograms per cubic meter, on August 31, 1972. This was the only value to exceed 200 micrograms per cubic meter since September 1971. This indicates that a significant reduction in oxidant levels in the vicinity of the monitor has occurred. Graphical presentation of highest hourly readings by day and by month, 1971 vs. 1972, indicate that a significant shift has occurred in oxidant levels. The values follow the same trend, just at significantly different levels of concentration. It is not felt that meteorological changes alone should cause an overall shift in values of this magnitude and consistency.

The most obvious reason for this reduction would be the improved traffic flow patterns around the monitor. It seems that the high values measured in August 1971 were due to the unusual traffic conditions in this area, the school bus situation, or some other unexplained localized phenomena. Based upon the preceding information it is not possible to unqualifiedly recommend a control strategy for the Dayton area. It, however, would be in the best interest of the residents of the Dayton area for efforts to be made to reduce vehicular contributed pollution in order to further improve air quality. Special effort should be made to increase use of the mass transit system. Use of the private automobile in the CBD should be discouraged, and effort to insure proper operation of these vehicles should be made, such as a periodic inspection and/or maintenance program. In addition, an adequate air quality monitoring system should be instituted and maintained in order to measure and provide updated projections of required emission reductions. As an interim measure to insure compliance, an episode control strategy could be implemented. It should be noted that if the air quality data is correct, projections indicate that the National Air Quality Standards would only be violated twice annually at the worst (once is permissible).

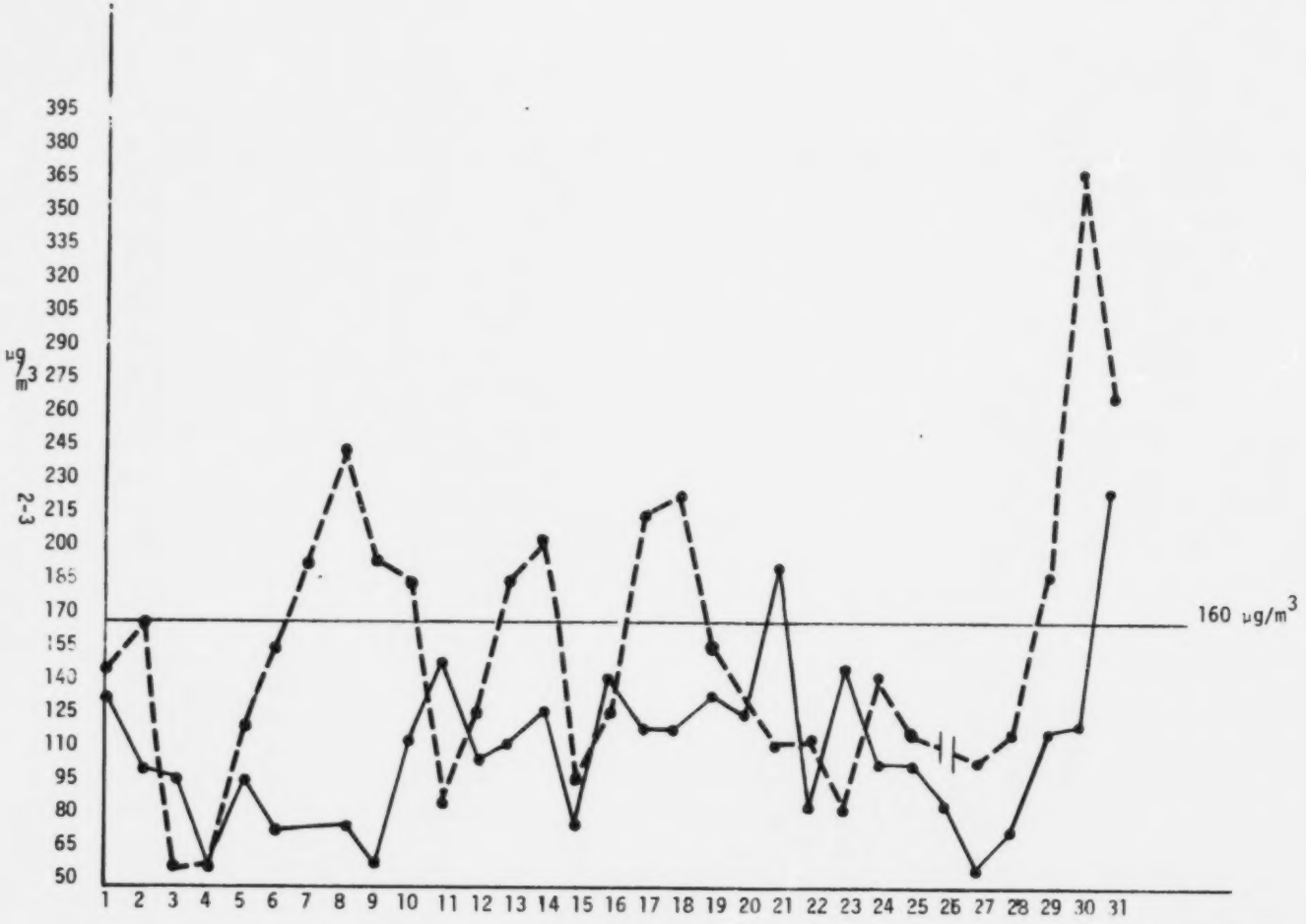

Figure 1. DAILY HIGH - OZONE - Micrograms/Cubic Meter

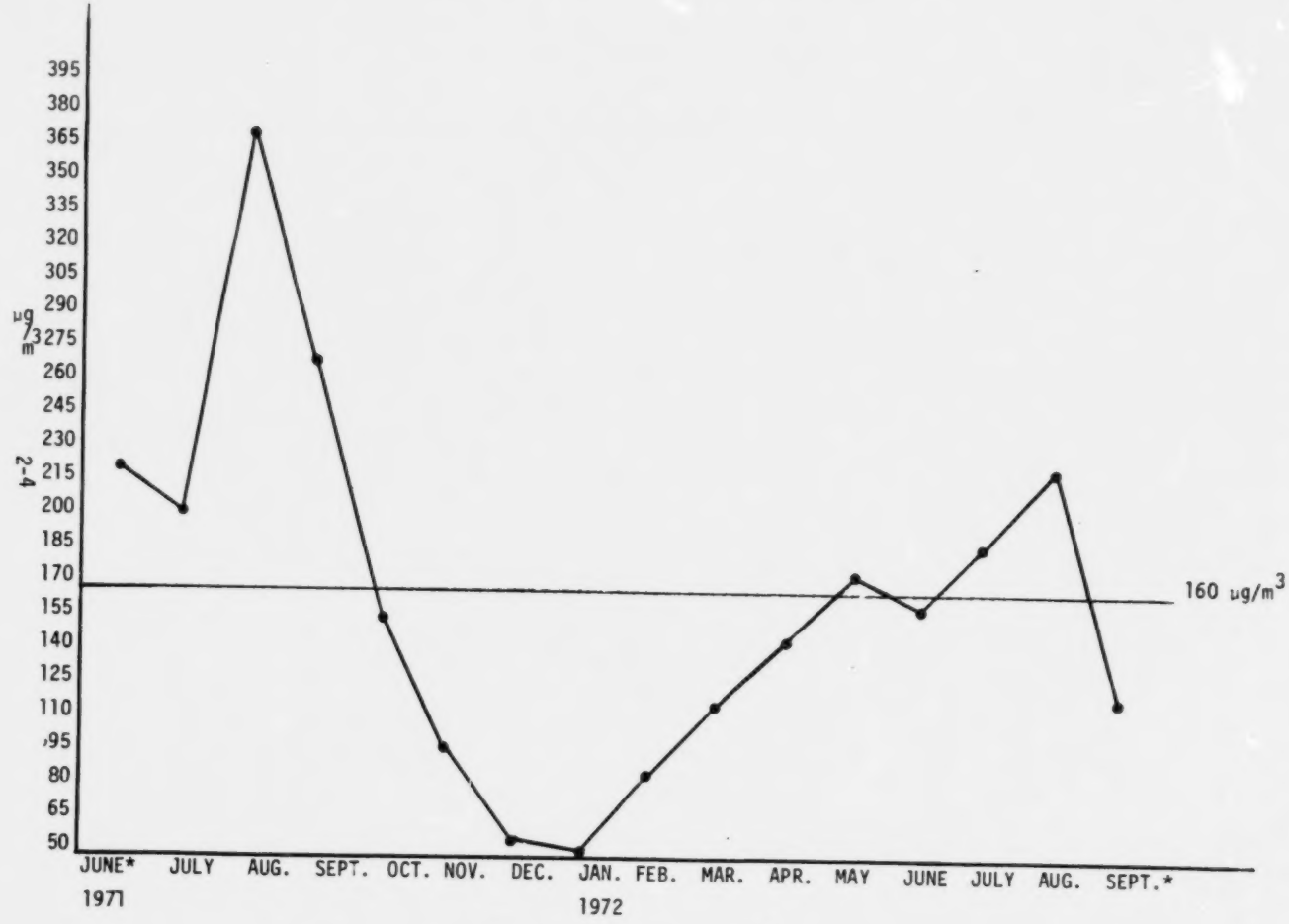

Figure 2. PEAK CONCENTRATION - OZONE - µg/M^3
BY MONTH

*Partial Month's Data

3.0 INTRODUCTION

The State of Ohio must submit definitive transportation control plans to the Environmental Protection Agency (EPA) no later than February 15, 1973, for that area of the State, namely the Dayton Region, where emissions from transportation sources have contributed to measured concentrations of pollutants in excess of the National Ambient Air Quality Standards. To assist the State in its preparation of this transportation plan, EPA has awarded a contract to TRW Inc., and its subsidiary De Leuw, Cather and Company for developing strategies for the Dayton Region that will achieve National Ambient Air Quality Standards for oxidants by the year 1977.

3.1 AREA DESCRIPTIONS

The Metropolitan Dayton Intrastate Air Quality Control Region is comprised of the following six counties:

- Clark
- Darke
- Greene
- Miami
- Montgomery
- Preple

These counties have a combined area of 2,715 square miles. Population (estimated) in 1969 was 1,039,000. Approximately 60 percent of the population is located in Montgomery County, and about half of that within the City of Dayton. The majority of the City of Dayton is located in Montgomery County, with the remainder in Greene County. Montgomery County has an area of 459 square miles and Greene County an area of 415 square miles.

The region has a diversified manufacturing base, and includes business machines, home appliances, rubber products and automobile components. Also located in the region, just northeast of the city is Wright-Patterson Air Force Base, a major military installation.

The Dayton metropolitan area lies within the Miami River Valley, approximately 50-200 feet below the elevation of the surrounding countryside. The Miami River drains southward to the Ohio River.

The wind for this region is generally from the south-southwest (except during Febraury-March when it is from the west-northwest). Wind speed averages about 8 miles per hour in the summer and 12 miles per hour during the winter. These winds tend to minimize local climatological conditions, and the region is more effected by stagnate air masses extending over large areas of the midwestern United States.

Precipitation is relatively evenly distributed throughout the year.

The temperature for this area is relatively moderate with occasional extremes of short duration[1].

3.2 PROBLEM DEFINITION AND DESCRIPTION

Based upon available data the Dayton Metropolitan Region's area of primary concern is photochemical oxidants; the products of hydrocarbons, nitrogen, oxides, and sunlight. A major source of these pollutants is mobile source emissions. During the monitoring program covering the past year and a half only one period of exceptionally high oxidant levels was recorded; during the month of August, 1971 levels generally exceeded permissible 1977 levels. One day in particular (August 30, 1971) had exceptionally high readings of 372 and 343 micrograms per cubic meter. These levels have not been repeated during any time since that date. During the Summer of 1972 only one day in excess of 200 micrograms per cubic meter was recorded (this level was 225 micrograms per cubic meter). Several factors are believed to have been involved in the reduction of the reported levels but no clear-cut absolute reason can be given.

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[1] Demographic and meteorological data extracted from the Ohio State Implementation Plan.

It should be emphasized that the existing data base for air quality is inadequate for accurate and reliable evaluation of control measure effects and emission reduction. In addition, stationary source data presented in the Ohio Implementation Plan is not as detailed or complete as is necessary for estimating future stationary source contributions to the problem.

4.0 CONTROL STRATEGY DEVELOPMENT

4.1 EMISSION ESTIMATES

To determine the magnitude of the emissions reduction required, it is necessary that the quantitative effect of emissions reductions on the level of concentration in the ambient air be determined. Methods for determining this effect vary in complexity. The more complex and, with sufficient data base, the more representative of actual conditions are diffusion models which use for inputs the emission rates of all sources (e.g., all streets plus all stationary sources), the concentration at the receptors, and source-receptor interaction. The latter is determined from and caries with meteorological conditions. The least complex is the simple proportional model which assumes that the reduction in air quality concentration levels is directly proportional to emission reductions. A proportional model was used to determine the required emission reductions needed in Dayton. The proportional model is described and the rationale for its use is detailed in Appendix A.

4.1.1 Methods

An emission estimate is the product of two factors; vehicle miles of travel (VMT) times an emission rate (emission factor) in grams pollutant per mile traveled. Emission factors were based on known or expected emission rates for each vehicle class considering age of vehicle, effectiveness of emission controls, average speed, and age distribution of the population of vehicles traveling within the Dayton study area[1]. The impact of Federal new motor vehicle exhaust system controls required on present and future vehicles were considered. Emission factor calculations are detailed in Appendix A.

VMT and speed were determined as shown in Appendix B. Estimates of VMT and speed within Dayton and its CBD were based principally on historical projections. Citywide travel was based on known 1972 traffic projected by

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(1) D.S. Kircher and D.P. Armstrong, "An Interim Report on Motor Vehicle Emission Estimation," Environmental Protection Agency, October 1972.

trends in auto ownership and screenline crossings. Travel within the CBD was based on trends reflected by cordon counts taken on its perimeter as well as a traffic flow map. Average speed on the major street system in Dayton was estimated at 28.0 miles per hour.

VMT and speed projections to 1977 were based on actual growth reflected by census, interim traffic counts, available real life data and judgement based on national trends. The projections also reflect the expected effects of major highway projects programmed for completion by 1977. Details on these projections are shown in Appendix B.

4.1.2 Emission Estimates with Present Transportation System and Controls (1971)

Estimated mobile source hydrocarbon emissions for 1971 were 86,693 kg/day overall for the Montgomery-Greene County area. Emission factors and VMT by vehicles class used for these estimates are given in Table 4-1.

4.1.3 Emission Estimates with Programmed Transportation System and Controls (1977)

Estimated mobile source hydrocarbon emissions for 1977 are 44,251 kg/day overall for the area. Emission factors and VMT by vehicle class used for these estimates are given in Table 4-2.

4.2 CONTROL MEASURES CONSIDERED

4.2.1 Emission Reduction Potential

Control measures are those actions taken that are expected to result in a reduction in total emissions. Control measures will fall into one of two groups; emission related, and reductions in vehicle miles traveled. Emission related control measures achieve reductions in emissions per vehicle mile by the use of emission control devices, by the use of alternative energy sources such as gaseous fuels and electric power, and speed control. The other group of control measures achieve reduction by reducing the vehicle miles traveled (VMT).

Table 4-1

1971
MOBILE HYDROCARBON EMISSIONS
FOR
MONTGOMERY AND GREEN COUNTIES
(Includes City of Dayton)

		(1)	(2)	(3)	(4)	
ROAD CATEGORY	AVERAGE SPEED (m.p.h.)	LIGHT DUTY (VMT/day)	EMISSION FACTOR[1] (grams/mile)	HEAVY DUTY (VMT/day)	EMISSION FACTOR[1] (grams/mile)	TOTAL EMISSIONS (kg/day)
Freeways & Expressways	46	2,165,306	7.191	143,123	16.463	17,927
Arterials	27	2,808,811	9.137	185,657	22.088	29,765
Collectors	20	2,834,890	10.222	187,381	24.810	33,627
Ramps	25	95,656	9.388	6,232	22.814	1,040
Local	15	271,337	10.775	52,306	26.961	4,334
TOTALS		8,696,009		574,790		86,693

$(5) = 10^{-3} \Sigma [(1) + (2)] + [(3) + (4)]$

[1]D.S. Kircher and D.P. Armstrong, "An Interim Report on Motor Vehicle Emission Estimation," Environmental Protection Agency, October 1972.

Table 4-2

1977
MOBILE HYDROCARBON EMISSIONS
FOR
MONTGOMERY AND GREENE COUNTIES
(Includes City of Dayton)

		(1)	(2)	(3)	(4)	
ROAD CATEGORY	AVERAGE SPEED (m.p.h.)	LIGHT DUTY (VMT/day)	EMISSION FACTOR[1] (grams/mile)	HEAVY DUTY (VMT/day)	EMISSION FACTOR[1] (grams/mile)	TOTAL EMISSIONS (kg/day)
Freeways & Expressways	46	3,234,000	2.355	213,835	10.892	9,945
Arterial	27	3,009,000	3.042	198,561	15.283	12,188
Collectors	21	3,287,000	3.498	217,472	16.979	15,190
Ramps	26	121,000	3.092	8,001	15.566	499
Local	16	1,001,000	3.813	66,187	18.678	5,053
Addition	32	252,000	2.906	16,729	13.862	964
Addition	26	100,000	3.092	6,546	15.566	411
TOTALS		11,004,000		727,330		44,251(5)

$(5) = 10^{-3} \Sigma [(1) + (2)] + [(3) + (4)]$

[1]D.S. Kircher and D.P. Armstrong, "An Interim Report on Motor Vehicle Emission Estimation," Environmental Protection Agency, October 1972.

EPA regulations require that light duty vehicles be equipped with emission controls that reduce emissions to specified limits. Hydrocarbon emission estimates indicate reductions by 1977 of 50 percent overall for the area through utilization of emission controls (see Table 1-1). The estimated reductions from emission controls are based on minimal low mileage test data (4000 mile) and for only pre-1972 models[2]. Reductions for later year models are estimated. A deterioration factor is applied to account for the aging or deterioration of the control devices beyond the low mileage test period estimates. The estimated reductions should not be relied on unequivocally until confirmed by additional test data.

Area wide total hydrocarbon emissions of 147,917 kg/day must be reduced 58 percent to 62,125 kg/day by 1977. It was estimated (Table 1-1) that new-vehicle emission controls will reduce emissions to 74,153 kg/day. Thus, control measures are needed to reduce emissions another 12,028 kg/day. This is equivalent to a 27.2 percent reduction of the 1977 mobile source emissions (an overall reduction of 16.2 percent).

4.2.2 Institutional Considerations

Any candidate control measure should be considered in relation to the economic, political, and social problems likely to be encountered upon its implementation. The various obstacles to the control measures considered for Dayton have been documented in the following section.

4.3 CONTROL MEASURES AND STRATEGY FOR DAYTON

4.3.1 Emission Reduction Measures

Inspection/Maintenance (Loaded Emission Test Without Retrofit)

An estimated 12 percent reduction in non-evaporative hydrocarbon emissions from light duty vehicles will result if this program is implemented. EPA considers this approach to be the most generally applicable

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(2) Ibid.

of the several inspection/maintenance alternatives for in-use vehicle emissions control. Therefore, their guidelines require that data and analyses supporting the emissions reductions claimed for alternative approaches must be submitted with the transportation control plan. This control measure has thus been included although other inspection/maintenance approaches may be chosen. It should be noted that if this strategy is applied to an area smaller than the region, the percent reduction achieved will be reduced by an amount dependent on the VMT traveled in the control area by uncontrolled vehicles.

The specific emission test considered is the Key Mode test which requires measurement of emissions during cruise, deceleration and idle modes of an acceleration - cruise - deceleration - idle cycle.*

Traffic Operations Improvements

This category of control measures includes improvements, other than construction of major new facilities, which will facilitate traffic flow, increase speed (within acceptable limits), and reduce the number of stops and starts occasioned by traffic congestion. Applicable traffic operations improvements include, among others, channelization of busy intersections; widening congested segments of heavily traveled thoroughfares; parking and/or loading restrictions or prohibitions; and traffic signal improvements to achieve better efficiency. It has been estimated that programmed improvements will result in a five-mile-per-hour increase in average operating speed on arterial streets and highways with a combined total of approximately 352,000 VMT per day, (Appendix B). The net effect will be an increase in average operating speed from 28.3 mph to 29.9 mph for the two-county region. While an increase of this magnitude may appear to be nominal, the effect would be significant in specific areas where congestion now exists and where pollutants concentrate.

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*"Control Strategies for In-Use Vehicles," Preliminary Draft, Environmental Protection Agency, August 9, 1972.

Gaseous Fuels

There is no single fleet of vehicles (such as taxicabs) in the Dayton Metropolitan Area which is large enough to warrant further consideration of this control measure. Estimated emission reduction which could be achieved through conversion to gaseous fuels is nominal.

Electrification

Of approximately 12,500 daily service miles operated by the City Transit Company (CTC)[1] in 1971, 90 percent were accounted for by electrically driven trolley buses and ten percent by diesel buses. Estimated emission reductions resulting from electrification of present diesel buses operated by RTC (formerly CTC) and other transit properties is nominal. Consideration has been given by others to the advisability of converting the present trolley bus fleet to diesel buses. Before such a conversion is made, the consequences in terms of increased air pollution--particularly in the Dayton central business district--should be carefully analyzed.

4.3.2 Vehicle Miles Traveled Reduction Measures

Control measures described above are all directed toward producing a decrease in the quantity of pollutants emitted per mile of vehicle travel. Alternative control measures would reduce emission by decreasing the amount of vehicle travel.

Improvements in Public Transportation

Transit patronage in Dayton has declined from 43,800,000 revenue passengers per year in 1950 to 9,390,000 in 1971, or by 79 percent[2]. Daily ridership in 1971 would have been 31,300 one-way trips per day assuming 300 equivalent weekdays per year. In 1971, travel by public transit accounted for less than two percent of all person trips made in the Dayton Metropolitan Area.

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(1) CTC was acquired by the Miami Valley Regional Transit Authority (MVRTA) on November 5, 1972.

(2) Source: The City Transit Company, February 24, 1972.

The electorates of Dayton and Oakwood voted on a Miami Valley Regional Transit Authority (MVRTA) special tax election on October 1, 1971. The citizens approved a tax levy for the MVRTA by a margin of nearly four-to-one. On November 5, 1972, following a year of negotiations and the filing of a condemnation suit, MVRTA took over operation of the City Transit Company.

MVRTA has developed a short-range transit improvement program including the following measures aimed at increasing patronage and service[1]:

- Management/Administration of the Transit System - the first steps have already been taken by public acquisition and retention of an experienced transit operator to manage the system.
- Transit Operations - route and schedule improvements to provide more attractive service levels. In addition, fares would be stabilized and slightly reduced through sale of 40-ride tickets as well as Senior Citizens' and Students' 20-ride tickets. All zone charges would be eliminated.
- Marketing Program - including improvements in public information, public relations, advertising and community relations.
- Capital Improvements - replacement of rolling stock and accessories as well as office and garage facilities. Purchase of new communications equipment, bus shelters and benches.
- Special Transit Planning Programs - other programs considered important to the system including the Dayton Urban Corridor Demonstration Program and Model Cities Transit Program.
- Additional Service - extension of transit service to presently unserved areas both within and outside of the District.
- Traffic Control Plan - measures recommended to alleviate specific traffic problems which impede bus travel.

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(1) Short-Range Transit Plan, Miami Valley Regional Transit Authority, Montgomery and Greene County Transportation and Development Planning Program (Consultant: ATE Management & Service Company), August 1972.

The short-range transit plan envisions a ridership increase of 35 percent over the next ten years, or an average rate of 3.5 percent per year. On the basis of this forecast, a transit patronage increase of 17.5 percent may be expected to occur during the period 1972 to 1977. This would result in an increase in daily trips from 31,300 in 1972 to 36,800 in 1977, or by 5,500 daily trips. If all of these increased transit trips were diverted from autos, the reduction in daily VMT would amount to 25,000[1], or about 0.2 percent of the estimated total by light vehicles.

While it appears that the short-range transit improvement program will have a nominal effect on regionwide emissions by 1975, this program is deemed to have far-reaching implications in later years. While consideration is being given to developing a rapid transit system; bus service improvements are a prerequisite to further transit development. In addition, the effect of VMT reduction would be greater in and around the Dayton central business district than in the entire two-county region and would be greater during congested peak hours than in the off-peak.

Vehicle Restraints

This category of VMT control measures includes restraints such as gasoline rationing, congestion passes, increased vehicle registration fees, traffic prohibition in the central area, and other means of decreasing the amount of vehicular travel and/or the number of vehicles owned by the populace. Most such measures would affect the life style of residents of the area and would be difficult to implement. They are considered a last resort to be used only if air quality standards cannot be met through use of other control measures.

The air quality problem in the Dayton Metropolitan Area is not serious enough at this time to warrant further consideration of vehicle restraints. Should air quality deteriorate to the point where other con-

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[1] Assuming 1.2 persons per car and 5.0 miles average trip length.

trol measures do not afford reductions necessary to meet ambient air quality standards, further consideration may be given to vehicle restraints.

Staggered Work Hours

This control measure will achieve a reduction of VMT in the peak hour by diverting some present peak hour trips to either an earlier or later time. Morning peak hour traffic is slightly less than in the evening. Work related travel is the greatest during the period from 4:00 p.m. to 5:00 p.m. (47.1 percent of total hourly auto trips). The p.m. peak hour, however, occurs between 5:00 p.m. and 6:00 p.m. when 8.9 percent of total daily auto trips are made.

Ten percent of work trips made during the peak morning and evening hours, could be diverted to either or both of the preceding or succeeding hours without increasing hourly VMT above that in the peak hour. It is estimated that this would require slight alteration of working hours for about 6,000 employees at the 1977 level of activity.

Estimated emissions reduction in the peak hour in the two-county area will be three percent if ten percent of peak hour work trips are shifted. A larger percentage reduction could probably not be attained without degrading air quality in the preceding or succeeding hours beyond the level expected to occur in the peak hour.

4.3.3 Episode Controls

An episode control plan is recommended for control of photochemical oxidant pollution in the Dayton region. While this type of strategy is not generally useful in providing for the attainment of National Ambient Air Quality Standards certain specific features of the Dayton problem appear to indicate the usefulness of this strategy.

1. Based on monitoring data extending from August, 1971 through September , 1972, the air quality standards appear to be exceeded on less than 10 days per year.

2. The highest photochemical oxidant measurements occur during period of general atmospheric stagnation. These stagnation periods are currently being forecasted and implementation of episode controls would not have to wait until air quality standards were actually exceeded.

3. The region is small enough, in terms of physical site and population, to permit significant diversion to non polluting transit on a short-term basis.

It is therefore recommended that an episode control plan be adopted for the Dayton region which incorporates the following features. Detailed elaboration of this plan should be conducted by State and Local officials and reported to EPA as a part of the second semi-annual report. The plan should:

1. Provide for plan activation based on a forecast of adverse meterological conditions and deteriorating air quality (i.e. 120 $\mu g/m^3$ oxidant).

2. Closing of all non essential operations, especially those which generate large numbers of auto trips such as shopping centers, theaters, etc.

3. Mobilization of available bus fleets (school buses, national guard vehicles) to provide essential transportation.

4. Strictly enforced limitation of private auto use on major arteries in the two county area surrounding Dayton.

The episode control strategy should provide the degree of reduction in hydrocarbon emissions required to prevent formation of levels of photochemical oxidants in quantities exceeding air quality standards. It is estimated that an episode along the lines described above will reduce mobile source hydrocarbon emissions by 30 to 40 percent. This is equivalent to a 20 percent overall reduction in hydrocarbon emissions and should allow attainment of air quality standards by 1977.

4.3.4 Air Quality Impact

The impact on air quality of the two-county study area will be a net reduction of 50 percent in hydrocarbon emissions by 1977 without any additional controls.

4.3.5 Cost Effectiveness

Due to the unusually large reductions required, only those few measures which either individually or in combination can be considered as usable strategies. Cost effectiveness cannot be determined for these alternatives, except that on a relative basis, episode control strategies could be slightly more cost effective.

4.3.6 Obstacles to Implementation

Since legal authority exists for inspection/maintenance in counties and for episode strategy, the major remaining obstacle to the definition of transportation control strategy is the justification for the need to implement any controls based on the currently available data.

Socio-economic and legal obstacles to the preceding control measures are considered below.

4.3.6.1 Emission Reduction Measures

Since some legal authority exists for Inspection/Maintenance in the counties the primary obstacle to implementation of such a program would be the initial costs for the loaded emission test. Traffic operations improvements are already planned for Dayton and implementation potential is dependent only on the enforceability of parking and loading restrictions.

Gaseous fuel conversions are considered ineffective for Dayton as described above and would also limit the availability of these low-pollution fuels to other sources.

4.3.6.2 VMT Reduction Measures

Improvements in public transportation is highly desireable for Dayton as shown by the questionnaire response in Appendix D. The citizens have already shown their commitment to the attainment of such improvemtns by a special tax to defray costs of this program. No obstacles to this group of control measures is foreseen.

Vehicle restraints require alterations in lifestyles which seem totally unacceptable to the general public (see questionnaire responses Appendix D). Special taxes or licenses would require legal authority which may be difficult to obtain in view of strong public opposition.

Staggered work hours can be implemented on a voluntary basis with very little difficulty however, such staggering over limited time periods may actually increase the total VMT due to work trips by discouraging car pooling. The impact of limited staggering on oxidant air quality may be negligible because the total morning hydrocarbon emissions can effect the afternoon oxidant values.

4.4 PROPOSED CONTROL STRATEGY

In consideration of the emission reduction potential and obstacles to implementation of the control measures described in the preceding sections the following control strategy is proposed.

- Phase 1 - Problem Evaluation and Planning

  In view of the limited air quality and emissions data a comprehensive program for the expansion and review of air quality monitoring network and stationary source emissions data should be completed no later than October 1974. During this period the Episode plan described in Section 4.3.3 should be fully developed and ready for implementation by Summer 1975 if necessary. Also during this period the requirements and regional extent of an Inspection/Maintenance Program most effective for the Dayton region must be defined and any preliminary testing performed.

Phase 2 - Control Measure Implementation

By June, 1975 the following control measures should be fully implemented in order to achieve maximum emission reduction potential by July, 1977.

1. Inspection/Maintenance - a loaded emission test of the Key Mode type with manditory annual inspection.
2. Transit and Traffic Improvements as described above and as currently planned.
3. An Episode Control Plan as described in Section 4.3.3 and detailed in Phase 1.

5.0 CONTROL STRATEGY IMPLEMENTATION

5.1 PROCEDURE AND TIME SCHEDULE

The primary concern for strategy implementation is to extend the data base for the Dayton area. Within one year an extended monitoring network should be established to insure adequate data on which to base any required control strategy. An updated and complete emission inventory is needed. This should be completed within six months.

Without the information provided by an extended data base and accurate emission inventory, control strategies cannot be developed effectively and long-term planning cannot effectively be carried out. An episode control plan could be implemented over a two year period if revised data and information show the necessity for a control strategy.

5.2 AGENCY INVOLVEMENT

In addition to the existing Montgomery County Health Department involvement in the Regional Air Pollution Control Agency, other groups and agencies should be involved in the overall program; the traffic engineering division for the City of Dayton and the corresponding group for the counties surrounding Dayton as well as the Miami Valley Regional Transit Authority.

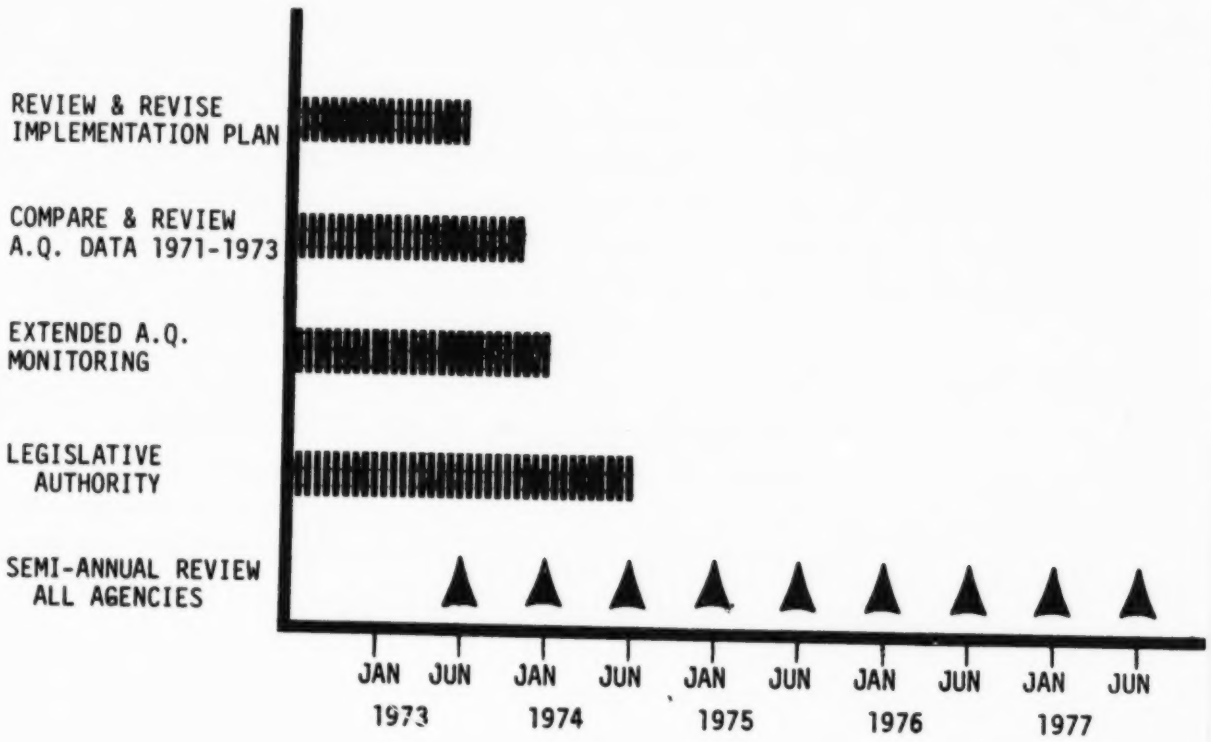
5.3 LEGAL AUTHORITY

The Implementation Plan for the State of Ohio documents that broad powers have been made available by the legislature of the State of Ohio. Certain specific interpretation or legislative action are required for implementation. Due to the lack of a defined control strategy, it is not possible to determine what legal requirements would have to be met for a control program. However, if vehicle inspection and maintenance is chosen or implemented as a control measure, data should be sought from the Ohio Air Pollution Control Board and State Attorney General's office. If an episode strategy is adopted, the legal authority for a broad range of powers exists and may be delegated to the local Air Pollution Control Board from the State Air Pollution Control Board. Measures which would probably affect the population of the region would have to be considered by the State Air Pollution Control Board. Those measures which specifically involve only the residents of the

City of Dayton should be investigated by the local city attorney.

5.4 IMPLEMENTATION, SURVEILLANCE AND CHECKPOINTS

Checkpoints outlined in the chart below should be closely followed with the semi-annual reviews being decision making points for the necessary changes in strategy


REVIEW & REVISE IMPLEMENTATION PLAN
COMPARE & REVIEW A.Q. DATA 1971-1973
EXTENDED A.Q. MONITORING
LEGISLATIVE AUTHORITY
SEMI-ANNUAL REVIEW ALL AGENCIES
JAN JUN JAN JUN JAN JUN JAN JUN JAN JUN
1973 1974 1975 1976 1977

Implementation, Surveillance and Checkpoints

APPENDIX A

AIR QUALITY AND EMISSIONS DATA

THE PROPORTIONAL AIR QUALITY MODEL

Hydrocarbon emission reduction was determined by use of Figure 1, Federal Register, Vol. 36, No. 228, Thursday, November 25, 1971, p 22413. This is a roll-back technique. More sophisticated mathematical models relating emissions to oxidant air quality require detailed emissions and meteorological data not available at this time.

EMISSION FACTOR CALCULATIONS

The equation for calculating emission factors is shown below:[1]

$$e_{np} = \sum_{i=n-12}^{n+1} ci \; di \; mi \; si$$

where,

e_{np} = emission factor in grams per vehicle mile for calendar year n and pollutant p,

c_i = the 1975 Federal test procedure emission rate for pollutant p (grams/mile) for the i^{th} model year, at low mileage

d_i = the controlled vehicle pollutant p emission deterioration factor for the i^{th} model year at calendar year n,

m_i = the weighted annual travel of the i^{th} model year during calendar year n (The determination of this variable involves the use of the vehicle model year distribution),

s_i = the weighted speed adjustment factor for the i^{th} model year vehicles.

c_i is based on a recent study of vehicle exhaust emission rates in six cities. d_i, deterioration factor accounts for the aging or deterioration of emission control devices. m_i, weighted annual mileage is determined as follows,

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[1] D.S. Kircher and D.P. Armstrong, "An Interim Report on Motor Vehicle Emission Estimation," Environmental Protection Agency, October 1972.

$$mi = \frac{V \times D}{\Sigma V \times D}$$

V = fraction of each model year vehicle in use on December 31 of year

D = average miles driven of each model year vehicle

s_i, speed adjustment factor, varies inversely with average route speed. 1975 and later model years are assumed to have a factor of one. For other model years, s_i is greater than one below about 20 m.p.h. and less than one above 20 m.p.h.

DAYTON
(Montgomery-Greene Counties)
NON-MOBILE EMISSION INVENTORY ANALYSIS
HYDROCARBONS

SOURCE CATEGORY	CONTROL FACTOR	GROWTH FACTOR[a] 1971	GROWTH FACTOR[a] 1977	MONTGOMERY CO.[b] (kg/day)(1971)	GREENE CO.[b] (kg/day)(1971)	TOTAL EMISSIONS (kg/day)(1971)	PROJECTED (kg/day)(1977)
Commercial, Institutional, Industrial	.90	1.03	1.18	9266	1365	10631	11290
Utility Fuel	.95	1.06	1.36	1792	0	1792	2315
Process Losses	.20	1.03	1.21	19617	480	20097	4863
Solid Waste Disposal	.20	1.02	1.15	3264	290	3554	817
Gasoline Handling Storage	.50(c)	1.06	1.34	7998	1777	9775	6549
Solvent Use	.15(c)	1.03	1.21	12836	980	13816	2508
Miscellaneous & Residential	1.0	1.00	1.00	1220	339	1559	1559
TOTALS				55993	4231	61224	29902

(a) Ohio Implementation Plan, Part I, pages 5-15, January 1972.

(b) Ohio Implementation Plan, Part II, Appendix C, January 1972, expressed in tons/year.

(c) Private Communication - J. Chicca, Region V, EPA - November 22, 1972, McLean, Va.

Table A-1

APPENDIX B
TRANSPORTATION DATA BASE

Table B-1

DAYTON - CENTRAL BUSINESS DISTRICT

VEHICLE MILES OF TRAVEL PER DAY--1971
BY LIGHT VEHICLES

Age (Years)	(1) Percent of Total Light Vehicles in Use	(2) Percent of Miles Driven on Annual Basis	(3) Weighted Percent of Daily Travel	Vehicle Miles of Travel by Light Vehicles (Thousands)
0*	3.5	3.8**	1.65	3.5
1	7.5	7.5**	6.97	14.9
2	11.7	11.4	16.53	35.4
3	11.6	10.4	14.95	32.0
4	11.4	9.5	13.42	28.6
5	10.7	8.5	11.27	24.1
6	9.7	7.8	9.38	20.0
7	8.5	7.1	7.48	16.0
8	7.7	6.4	6.11	13.1
9	5.4	5.9	3.95	8.4
10	3.9	5.5	2.66	5.7
11	2.6	5.4	1.74	3.7
12	1.4	5.4	0.94	2.0
13+	4.4	5.4	2.95	6.3
Total	100.0	100.0	100.00	213.7

$$(3) = \frac{(1) \times (2)}{\Sigma(1 \times 2)}$$

*-Refers to next years model introduced in the Fall.
**-This percent reflects the fact that some vehicles in this age category have not been driven for a full year.

Light Vehicles	Vehicle Miles of Travel	Percent of Total Vehicle Miles of Travel
Autos and Taxis	198,271	87.0
Light Trucks	15,497	6.8
Total	213,769	93.8

Table B-2

DAYTON - CENTRAL BUSINESS DISTRICT

VEHICLE MILES OF TRAVEL PER DAY-- 1971
BY HEAVY VEHICLES

Age (Years)	(1) Percent of Total Heavy Vehicles in Use	(2) Percent of Miles Driven on Annual Basis	(3) Weighted Percent of Daily Travel	Vehicle Miles of Travel by Heavy Vehicles (Thousands)
0*	3.4	3.6**	1.65	0.2
1	7.1	7.6**	7.30	1.0
2	10.0	11.6	15.71	2.2
3	9.5	10.9	13.64	1.9
4	8.8	10.2	12.15	1.8
5	8.0	9.4	10.19	1.5
6	7.0	8.5	8.06	1.1
7	6.2	7.7	6.46	0.9
8	5.3	6.9	4.94	0.7
9	3.8	6.2	3.18	0.4
10	3.7	5.3	2.66	0.4
11	3.3	4.6	2.05	0.3
12	3.2	3.8	1.64	0.2
13+	20.7	3.7	10.37	1.5
Total	100.0	100.0	100.00	14.1

$$(3) = \frac{(1) \times (2)}{\Sigma(1 \times 2)}$$

*-Refers to next years model introduced in the Fall.
**-This percent reflects the fact that some vehicles in this age category have not been driven for a full year.

Heavy Vehicles	Vehicle Miles of Travel	Percent of Total Vehicle Miles of Travel
Medium and Heavy Trucks and Buses	14,129	6.2

Table B-3

DAYTON - MONTGOMERY-GREENE COUNTIES

VEHICLE MILES OF TRAVEL PER DAY--1971
BY LIGHT VEHICLES

Age (Years)	(1) Percent of Total Light Vehicles in Use	(2) Percent of Miles Driven on Annual Basis	(3) Weighted Percent of Daily Travel	Vehicle Miles of Travel by Light Vehicles (Thousands)
0*	3.5	3.8**	1.65	143.5
1	7.5	7.5**	6.97	606.1
2	11.7	11.4	16.53	1437.5
3	11.6	10.4	14.95	1300.1
4	11.4	9.5	13.42	1167.1
5	10.7	8.5	11.27	980.1
6	9.7	7.8	9.38	815.8
7	8.5	7.1	7.48	650.5
8	7.7	6.4	6.11	531.3
9	5.4	5.9	3.95	343.5
10	3.9	5.5	2.66	231.3
11	2.6	5.4	1.74	151.3
12	1.4	5.4	0.94	81.7
13+	4.4	5.4	2.95	256.6
Total	100.0	100.0	100.00	8696.4

$$(3) = \frac{(1) \times (2)}{\Sigma (1 \times 2)}$$

*-Refers to next years model introduced in the Fall.
**-This percent reflects the fact that some vehicles in this age category have not been driven for a full year.

Light Vehicles	Vehicle Miles of Travel	Percent of Total Vehicle Miles of Travel
Autos and Taxis	8,061,040	87.0
Light Trucks	635,440	6.8
Total	8,696,480	93.8

Table B-4

DAYTON - MONTGOMERY-GREENE COUNTIES

VEHICLE MILES OF TRAVEL PER DAY--1971
BY HEAVY VEHICLES

Age (Years)	(1) Percent of Total Heavy Vehicles in Use	(2) Percent of Miles Driven on Annual Basis	(3) Weighted Percent of Daily Travel	Vehicle Miles of Travel by Heavy Vehicles (Thousands)
0*	3.4	3.6**	1.65	9.5
1	7.1	7.6**	7.30	41.9
2	10.0	11.6	15.71	90.3
3	9.5	10.9	13.64	78.4
4	8.8	10.2	12.15	69.9
5	8.0	9.4	10.19	58.6
6	7.0	8.5	8.06	46.4
7	6.2	7.7	6.46	37.1
8	5.3	6.9	4.94	28.4
9	3.8	6.2	3.18	13.8
10	3.7	5.3	2.66	15.3
11	3.3	4.6	2.05	11.8
12	3.2	3.8	1.64	9.5
13+	20.7	3.7	10.37	59.6
Total	100.0	100.0	100.00	575.0

$$(3) = \frac{(1) \times (2)}{\Sigma(1 \times 2)}$$

*-Refers to next years model introduced in the Fall.
**-This percent reflects the fact that some vehicles in this age category have not been driven for a full year.

Heavy Vehicles	Vehicle Miles of Travel	Percent of Total Vehicle Miles of Travel
Medium and Heavy Trucks and Buses	574,789	6.2

Table B-5

DAYTON - CENTRAL BUSINESS DISTRICT

VEHICLE MILES OF TRAVEL PER DAY--1977
BY LIGHT VEHICLES

Age (Years)	(1) Percent of Total Light Vehicles in Use	(2) Percent of Miles Driven on Annual Basis	(3) Weighted Percent of Daily Travel	Vehicle Miles of Travel by Light Vehicles (Thousands)
0*	3.5	3.8**	1.65	4.4
1	7.5	7.5**	6.97	18.6
2	11.7	11.4	16.53	44.1
3	11.6	10.4	14.95	39.9
4	11.4	9.5	13.42	35.8
5	10.7	8.5	11.27	30.0
6	9.7	7.8	9.38	25.0
7	8.5	7.1	7.48	19.9
8	7.7	6.4	6.11	16.3
9	5.4	5.9	3.95	10.5
10	3.9	5.5	2.66	7.1
11	2.6	5.4	1.74	4.6
12	1.4	5.4	0.94	2.5
13+	4.4	5.4	2.95	7.9
Total	100.0	100.0	100.00	266.6

$$(3) = \frac{(1) \times (2)}{\Sigma(1 \times 2)}$$

*-Refers to next years model introduced in the Fall.
**-This percent reflects the fact that some vehicles in this age category have not been driven for a full year.

Light Vehicles	Vehicle Miles of Travel	Percent of Total Vehicle Miles of Travel
Autos and Taxis	247,289	87.0
Light Trucks	19,328	6.8
Total	266,617	93.8

Table B-6

DAYTON - CENTRAL BUSINESS DISTRICT

VEHICLE MILES OF TRAVEL PER DAY--1977
BY HEAVY VEHICLES

Age (Years)	(1) Percent of Total Heavy Vehicles in Use	(2) Percent of Miles Driven on Annual Basis	(3) Weighted Percent of Daily Travel	Vehicle Miles of Travel by Heavy Vehicles (Thousands)
0*	3.4	3.6**	1.65	0.3
1	7.1	7.6**	7.30	1.3
2	10.0	11.6	15.71	2.7
3	9.5	10.9	13.64	2.4
4	8.8	10.2	12.15	2.1
5	8.0	9.4	10.19	1.8
6	7.0	8.5	8.06	1.4
7	6.2	7.7	6.46	1.1
8	5.3	6.9	4.94	0.9
9	3.8	6.2	3.18	0.6
10	3.7	5.3	2.66	0.5
11	3.3	4.6	2.05	0.4
12	3.2	3.8	1.64	0.3
13+	20.7	3.7	10.37	1.8
Total	100.0	100.0	100.00	17.6

$$(3) = \frac{(1) \times (2)}{\Sigma (1 \times 2)}$$

*-Refers to next years model introduced in the Fall.
**-This percent reflects the fact that some vehicles in this age category have not been driven for a full year.

Heavy Vehicles	Vehicle Miles of Travel	Percent of Total Vehicle Miles of Travel
Medium and Heavy Trucks and Buses	17,623	6.2

Table B-7

DAYTON - MONTGOMERY-GREENE COUNTIES

VEHICLE MILES OF TRAVEL PER DAY--1977
BY LIGHT VEHICLES

Age (Years)	(1) Percent of Total Light Vehicles in Use	(2) Percent of Miles Driven on Annual Basis	(3) Weighted Percent of Daily Travel	Vehicle Miles of Travel by Light Vehicles (Thousands)
0*	3.5	3.8**	1.65	181.6
1	7.5	7.5**	6.97	767.0
2	11.7	11.4	16.53	1,818.9
3	11.6	10.4	14.95	1,645.1
4	11.4	9.5	13.42	1,476.7
5	10.7	8.5	11.27	1,240.1
6	9.7	7.8	9.38	1,032.2
7	8.5	7.1	7.48	823.1
8	7.7	6.4	6.11	672.3
9	5.4	5.9	3.95	434.6
10	3.9	5.5	2.66	292.7
11	2.6	5.4	1.74	191.5
12	1.4	5.4	0.94	103.4
13+	4.4	5.4	2.95	324.6
Total	100.0	100.0	100.00	11,003.8

$$(3) = \frac{(1) \times (2)}{\Sigma(1 \times 2)}$$

*-Refers to next years model introduced in the Fall.
**-This percent reflects the fact that some vehicles in this age category have not been driven for a full year.

Light Vehicles	Vehicle Miles of Travel	Percent of Total Vehicle Miles of Travel
Autos and Taxis	10,206,081	87.0
Light Trucks	797,717	6.8
Total	11,003,798	93.8

Table B-8

DAYTON - MONTGOMERY-GREENE COUNTIES

VEHICLE MILES OF TRAVEL PER DAY--1977
BY HEAVY VEHICLES

Age (Years)	(1) Percent of Total Heavy Vehicles in Use	(2) Percent of Miles Driven on Annual Basis	(3) Weighted Percent of Daily Travel	Vehicle Miles of Travel by Heavy Vehicles (Thousands)
0 *	3.4	3.6**	1.65	12.0
1	7.1	7.6**	7.30	53.1
2	10.0	11.6	15.71	114.3
3	9.5	10.9	13.64	99.2
4	8.8	10.2	12.15	88.4
5	8.0	9.4	10.19	74.1
6	7.0	8.5	8.06	58.6
7	6.2	7.7	6.46	47.0
8	5.3	6.9	4.94	35.9
9	3.8	6.2	3.18	23.1
10	3.7	5.3	2.66	19.4
11	3.3	4.6	2.05	14.9
12	3.2	3.8	1.64	11.9
13+	20.7	3.7	10.37	75.4
Total	100.0	100.0	100.00	727.3

$$(3) = \frac{(1) \times (2)}{\Sigma (1 \times 2)}$$

*-Refers to next years model introduced in the Fall.
**-This percent reflects the fact that some vehicles in this age category have not been driven for a full year.

Heavy Vehicles	Vehicle Miles of Travel	Percent of Total Vehicle Miles of Travel
Medium and Heavy Trucks and Buses	727,330	6.2

TABLE B-9

1971

Vehicle Miles of Travel per Day

for Central Business District, Dayton, Ohio

For 1968* to 1970** @ 2% per year compounded			
	211,130 x 1.0404	=	219,660
For 1970* to 1971***@ 4% per year compounded			
	219,000 x 1.04	=	228,446
Trucks:	5.7% x 228,446	=	13,021
Buses:	0.5% x 228,446	=	1,142
	VMT/day by Heavy Vehicles	=	14,163
Passenger Cars:	86.9 x 228,446	=	198,520
Taxis:	0.1 x 228,446	=	228
Panels and Pickups:	6.8 x 228,446	=	15,534
	VMT/day by Light Vehicles	=	214,282

*-1968 counts for vehicle miles of travel for Central Business District were taken from Dayton - 1968 survey adjusted trip table, second assignment.

**-Use 2% per year compounded for 1970 VMT.

***-Use 4% per year compounded for 1971 VMT.

TABLE B-10

1971

Vehicle Miles of Travel per Day

for Montgomery-Greene Counties, Ohio

For 1968* to 1970** @ 2% per year compounded 8,568,081 x 104.04	=	8,914,230
For 1970 to 1971*** @ 4% per year compounded 8,914,230 x 1.04	=	9,270,799
Trucks: 5.7% x 9,270,799	=	528,436
Buses: 0.5% x 9,270,799	=	46,354
VMT/day by Heavy Vehicles	=	574,790
Passenger Cars and Taxis: 87.0 x 9,270,799	=	8,065,595
Panels and Pickups: 6.8 x 9,270,799	=	630,414
VMT/day by Light Vehicles	=	8,696,069

*-1968 counts for vehicle miles of travel for Montgomery-Greene Counties were taken from Dayton - 1968 survey adjusted trip tables, second assignment. (The data was actually collected in late 1968 and early 1969 and therefore the projection to 1970 required only a 4% increase over recorded values.)

**-Use 2% per year compounded for 1970 VMT.

***-Use 4% per year compounded for 1971 VMT.

TABLE B-11

1977

Vehicle Miles of Travel per Day

for Central Business District, Dayton, Ohio

For 1970-1977*	7 years @ 3.75% per year compounded 219,660 x 129.4	= 284,240
Trucks and Buses:	6.2% x 284,240	= 17,623
VMT/day by Heavy Vehicles		= 17,623
Passenger Cars and Taxis:	87.0% x 284,240	= 247,289
Panels and Pickups:	6.8% x 284,240	= 19,328
VMT/day by Light Vehicles		= 266,617

*-Reference for projections, using the Origin and Destination Report, Part Two, for Predicting the Future Volume of Vehicle Trips, April 1962, pages 21 and 22 by the Regional Transportation Committee, Dayton, Ohio.

TABLE B-12

1977

Vehicle Miles of Travel per Day

for Montgomery-Greene Counties, Ohio

For 1970-1977*	7 years @ 4.00% per year compounded 8,914,231 x 131.6	= 11,731,128
Trucks and Buses:	6.2% x 11,731,128	= 727,330
VMT/day by Heavy Vehicles		= 727,330
Passenger Cars and Taxis:	87.0% x 11,731,128	= 10,206,081
Panels and Pickups:	6.8% x 11,731,128	= 797,717
VMT/day by Light Vehicles		= 11,003,798

*-Reference for projections, using the Origin and Destination Report, Part Two for Predicting the Future Volume of Vehicle Trips, April, 1962. Figure between page 2 and 3. For the Motor Vehicle Registration, Montgomery County by the Regional Transportation Committee, Dayton, Ohio.

TABLE B-13

1978

Vehicle Miles of Travel per Day

for Central Business District, Dayton, Ohio

For 1970-1978*	8 years @ 3.75% per year compounded 219,660 x 1.342	= 294,887
Trucks and Buses:	6.2% x 294,887	= 18,283
	VMT/day by Heavy Vehicles	= 18,283
Passenger Cars and Taxis:	87.0% x 294,887	= 256,552
Panels and Pickups:	6.8% x 294,887	= 20,052
	VMT/day by Light Vehicles	= 276,604

*-Reference for projections, using the Origin and Destination Report, Part Two for Predicting the Future Volume of Vehicle Trips, April, 1962. Figure between page 2 and 3. For the Motor Vehicle Registration, Montgomery County by the Regional Transportation Committee, Dayton, Ohio.

Table B-14

1978

VEHICLE MILES OF TRAVEL PER DAY
FOR MONTGOMERY-GREENE COUNTIES, OHIO

For 1970-1978*, 8 years @ 4.0% per year compounded:		
	8,914,231 x 1.369	= 12,199,716
Trucks and Buses:		
	6.2% x 12,199,716	= 756,382
VMT/day by Heavy-Duty Vehicles:		= 756,382
Passenger Cars and Taxis:		
	87.0% x 12,199,716	= 10,715,753
Panel and Pickup:		
	6.8% x 12,199,716	= 829,581
VMT/day by Light-Duty Vehicles:		= 11,443,334

*Reference for projections, using the Origin and Destination Report, Part Two for Predicting the Future Volume of Vehicle Trips, April 1962. Figure between page 2 and 3. For the Motor Vehicle Registration, Montgomery County by the Regional Transportation Committee, Dayton, Ohio.

CALCULATING OVERALL AVERAGE SPEED FOR THE YEARS 1971 AND 1977

Reference: Travel Time Inventory
Dayton Metropolitan Area, July 1972
Prepared by:
Montgomery and Greene County Transportation and Development Planning Program

From Table 3, pages 20 and 21

Average Speed in M.P.H. on Classified Routes

Routes	Morning 1971	Afternoon 1971
Freeways and Expressways	47.8	45.0
Radial Arterials	24.2	24.4
Circumferential Arterials	30.6	32.8

Using the following breakdown for our purposes of roadway classifications for speeds.

Class	M.P.H.*
1) Freeways and expressways	46.0 (A)
2) Arterials	27.0 (B)
3) Collectors	20.0
4) Ramps	25.0
5) Local streets	15.0

*-Averaged

(A) Average of 1970 = $\frac{47.8 + 45.0}{2}$ = 46.4 (Say 46.0 m.p.h.)

(B) Assume (1) 2/3 Travel on Radial Arterials
(2) 1/3 Travel on Circumferential Arterials

From Average Speeds 24.3 x 2 = 48.6
31.7 x 1 = 31.7

80.3 ÷ 3 = 26.7
Say 27 m.p.h.

From Vehicle Miles of Travel by Functional Classification - 1968 Survey, Second Assignment

Classification	VMT
Freeways and Expressways	2,137,383
Arterials	2,748,073
Collectors	2,807,351
Ramps	97,094
Local Streets	778,180

To figure overall average of speed for the year 1971, we used the 1971 VMT with the same proportions for each roadway classification as shown in 1968.

	1970 VMT		1971 Speed M.P.H		
Freeways and Expressways	2,308,429	x	46.0	=	106,187,734
Arterials	2,994,468	x	27.0	=	80,850,636
Collectors	3,022,281	x	20.0	=	60,447,620
Ramps	101,979	x	25.0	=	2,549,475
Local	843,643	x	15.0	=	12,654,645
	9,270,799				262,690,110

Overall Average Speed in 1971: 28.3 m.p.h.

TCC Annual Report for the Regional Transportation Plan
New Roads and Freeways to be added between the years 1971-1975.

Additional freeways in Montgomery County (Beltway)

16 miles	@	20,000 A. D. T.	=	320,000
2.3 miles	@	15,000 A. D. T.	=	35,000
7.6 miles	@	10,000 A. D. T.	=	76,000

North-South additional freeways in Montgomery County

3.8 miles	@	10,000 A. D. T.	=	38,000
1.6 miles	@	15,000 A. D. T.	=	24,000
		Total		493,000 VMT

Additional freeway - Greene County

14.4 miles @ 3,000 A. D. T.

Additional roads in Montgomery County @ 5 m. p. h. increase speed

3.4 miles	x	10,000	=	34,000
3.4 miles	x	10,000	=	34,000
2.3 miles	x	4,000	=	9,000
1.7 miles	x	14,000	=	24,000
0.9 miles	x	11,000	=	10,000
0.8 miles	x	9,000	=	7,000
1.0 miles	x	17,000	=	17,000
1.5 miles	x	10,000	=	15,000
2.3 miles	x	15,000	=	34,000
1.7 miles	x	4,000	=	7,000
3.8 miles	x	10,000	=	38,000
1.4 miles	x	5,000	=	7,000
1.4 miles	x	4,000	=	6,000
1.0 miles	x	8,000	=	8,000
8.0 miles	x	10,000	=	80,000
4.5 miles	x	5,000	=	22,000
		Total		352,000 VMT

ADJUSTMENTS FOR PROJECTED 1977 VMT

(1)	Freeways and Expressways	2,741,000 VMT	1977 projected
	Add	493,000 VMT	Additional freeway improvements
	Total	3,234,000 VMT	1977 adjusted
(2)	Arterials	3,554,000 VMT	1977 projected
	Subtract	293,000 VMT	A portion added to freeway
		3,261,000	
	Subtract	252,000 VMT	To be 5 mph higher
	Total	3,009,000 VMT	1977 adjusted
(3)	Collectors	3,587,000 VMT	1977 projected
	Subtract	200,000 VMT	A portion added to freeway
		3,387,000 VMT	
	Subtract	100,000 VMT	To be 5 mph higher
	Total	3,287,000 VMT	1977 adjusted
(4)	Ramps	121,000 VMT	Projected
(5)	Local	1,001,000 VMT	Projected
	Addition	252,000 VMT	@ 32 mph
	Addition	100,000 VMT	@ 26 mph

	1977 VMT				1977 Speed MPH
Freeways and Expressways	3,234,000	x	46.0	=	148,764,000
Arterials	3,009,000	x	27.0	=	81,243,000
Collectors	3,287,000	x	21.0	=	69,027,000
Ramps	121,000	x	26.0	=	3,146,000
Local	1,001,000	x	16.0	=	16,016,000
Addition	252,000	x	32.0	=	8,064,000
Addition	100,000	x	26.0	=	2,600,000
	11,004,000				328,860,000

Overall average speed in 1977: 29.9 m.p.h.

From the above, it should be noted that with the additional freeways, expressways, arterials and streets proposed by the TCC Report for the Regional Transportation Plan of Montgomery and Greene Counties, the overall average speed increases about (1.6) m.p.h. on the network of roads for those two counties in a period of six (6) years.

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APPENDIX D
AUTO AIR POLLUTION STUDY

V. QUESTIONNAIRE

AUTO AIR POLLUTION QUESTIONNAIRE
DAYTON METROPOLITAN AREA

The questionnaire shown in Figure was sent to a panel of residents of the Dayton Metropolitan Area to obtain their views on factors affecting auto air pollution and potential control measures. A total of 99 usable questionnaires were returned. The sample was selected by Consumer Mail Panels to be representative of the population of the area in terms of income level and age. Annual family income (1971) of respondents was:

Less than $8,000	27%
$8,000-$15,000	56%
More than $15,000	17%

Their home locations were distributed as follows throughout the metropolitan area:

Location	Number of Respondents	Percent of Total
Dayton	48	48.7
Fairborn	5	5.0
Kettering	5	5.0
Piqua	5	5.0
Troy	5	5.0
Miamisburg	4	4.0
West Carrollton	4	4.0
Xenia	4	4.0
Other	19	19.3
	99	100.0

Each respondent was asked to indicate the number of autos owned in his household. Answers were as follows:

No car	3%
One car	34%
Two cars	49%
Three or more cars	14%

Questionnaire responses were tabulated by income level and car ownership status of each panel member's family. Results of the survey follow with appropriate explanatory notes.

1. All autos made in 1975 and thereafter will be equipped with emmision control devices to reduce air pollution. If in 1975 you owned a car built before that year, how would you feel about a law requiring you to put emission control equipment which might cost $200 on your car? ("X" BELOW)

2. How would you feel about this law if the cost was reduced by government subsidy to about $50? ("X" BELOW)

Feeling Toward Law:	1. Cost $200	2. Cost $50
Very much in favor of law..	11.1%	45.7%
Somewhat in favor of law...	23.5	21.7
Somewhat against law.....	24.7	12.0
Very much against law.....	40.7	20.6

3a. Even cars properly equipped with emmision control equipment might still pollute the air if the equipment was not properly maintained. How would you feel about a law requiring periodic inspection of the emission control system to assure that it was working properly? ("X" ONE ONLY)

Very much in favor of law	Somewhat in favor of law	Somewhat against law	Very much against law
42.4%	35.4%	11.1%	11.1%

3b. Assuming you had to have your car inspected at least once a year, what would you consider a reasonable cost for the inspection? (WRITE IN AMOUNT)

$ 8.20 (Avg.)

One-eighth of the respondents answered "nothing" to this question. The most frequent response (30.2%) was "five dollars" followed by 20.8 percent of the panel who answered "ten dollars". The mean value given by all respondents who owned one or more cars was approximately $8.50. The following is a tabulation of the mean value by car ownership status of the panel member's family.

No car	$21.42
One car	7.13
Two cars	9.23
Three or more cars	7.69

3c. Assuming you had to have your car inspected at least once a year, where do you think the inspection should be made? ("X" ONE ONLY)

At state-operated inspection centers.....	42.7%
At city-operated inspection centers.....	16.7
At local service stations or garages.....	32.3
At some other place (Specify):	8.3

The "other" responses to this question were varied, but several panel members suggested that inspection should be accomplished by the auto dealers.

4a. Even if all autos were equipped with properly maintained emission control systems, some cities might still have auto air pollution problems due to the large number of cars either on the streets at the same time or concentrated in particular areas. Listed below are several possible ways to reduce pollution under one or both of these conditions. Please tell me how you feel about <u>each</u> of these proposals. ("X" ONE ON EACH LINE)

Proposal	To Me This Plan Is: Very Acceptable (+2)	Somewhat Acceptable (+1)	Neither Acceptable Nor Unacceptable (0)	Somewhat Unacceptable (-1)	Very Unacceptable (-2)
a. Gasonline rationing	5.3	8.4	3.2	12.6	70.5▲
b. Very high ($500) registration fee per auto.	1.1	1.1	2.1	5.3	90.4▲
c. Very high ($500) registration fee per auto but only for the second, third, etc., auto	5.3	9.5	5.3	17.9	62.1▲
d. Prohibit traffic and parking in central business districts	20.8	33.3▲	12.5	13.5	19.8
e. A tax on <u>all day</u> parking in central business districts	17.2	21.5	11.8	18.3▲	31.2
f. A tax on parking in central business districts regardless of whether a person parked only one hour or all day	6.3	18.8	17.7	17.7▲	39.6
g. Tolls on exit ramps of major freeways and expressways	3.2	6.3	9.5	21.1	60.0▲
h. Tolls on exit ramps of major freeways and expressways but only when traffic was heavy	1.0	11.5	12.5	17.7	57.3▲
i. Restrictions on non-essential auto travel during times of high pollution by issuance of special license plates or vehicle stickers	12.6	18.9	8.4	8.4▲	51.6
j. Turn some existing lanes into "bus only" and "car pool only" lanes on major expressways and streets	29.6	31.6▲	11.2	14.3	13.3

▲- Indicates the weighted mean for each answer.

4b. Which of the proposals listed above would be the most acceptable? (Give Letter:) J - 36.3%
D - 33.0%

4c. Which would be most unacceptable? ..... (Give Letter:) B - 59.1%
A - 26.9%

QUESTIONS 5-8 ASK FOR INFORMATION RELATING TO OTHER HOUSEHOLD MEMBERS. CONSULT THEM, IF NECESSARY, FOR THE ANSWERS.

5a. How often do the various members of your household travel by public transportation? (For example, by bus, subway, or commuter train.)

	Husband	Wife	Children (Over 16 Years Old)
Three or more times a week.	1.1%	4.2%	7.4%
One or two times a week.....	1.1	0.0	0.0
Once a month.....	1.1	2.1	3.7
Once every three months	5.6	12.5	3.7
Never	84.4	81.2	50.0
No household member	6.7	0.0	35.2

5b. Please rate each household member's reason for using public transportation. (Rate the most important reason "1", the next most important "2", the next "3", etc. If a household member never uses public transportation, "X" the "never use" box at the bottom of the list.)

5c. Please rate each household member's reasons for traveling by auto. Follow the same procedure as in Question 5b. (WRITE IN BELOW UNDER 5c)

CONCENSUS RATING

Reasons	5b. Public Transportation			5c. Auto Transportation		
	Husband	Wife	Children (Over 16 Years Old)	Husband	Wife	Children (Over 16 Years Old)
a. Cheaper				6	6	6
b. Faster				3	3	2
c. More comfortable				4	4	4
d. Safer for passenger.				8	8	7
e. Less congested.				6	7	8
f. More available	SEE COMMENTS			1	1	1
g. More flexible (I can come and go as I please)				2	2	3
h. More relaxing (able to read while traveling)				----NOT APPLICABLE-----		
i. Need car during the day				4	5	5
j. I do not have a driver's license				----NOT APPLICABLE-----		
k. Car is not available when I need it				----NOT APPLICABLE-----		
l. Other (Specify): _____				SEE COMMENTS		
m. Never use ("X" Box)	76/84	78/96	27/35	3/84	7/96	5/35

Comment on Question 5b

So few respondents indicated transit usage that answers to this question are not meaningful. Of 215 family members answering the questionnaire, 181, or 85 percent, said they never used transit. Of the few respondents who used public transit, their main reasons were "less congested", "more relaxing" and "more flexible", in that order.

Comment on Question 5c

Respondents indicated that the main reason for driving was the lack of mass transit near their residence. Some indicated that a car was needed because of the nature of their work.

5d. Again, consulting other members of your household, please rate in order of effectiveness which items below you feel would be most effective in encouraging the use of public transporation. (Rate the most effective item a "1", the next most effective "2", the next "3", etc.)

Items:	CONCENSUS RATING Husband	Wife	Children (Over 16 Years Old)
Cleaner and newer vehicles..	6	5	5
Faster travel	2	4	3
Air-conditioned vehicles	9	9	6
More frequent service	1	1	1
Lower fares	3	2	2
Parking facilities at stops or stations	5	6	8
Shelters against bad weather at stops or stations	7	8	7
Better security to assure personal safety.....	8	7	9
More conveniently located stops and stations	4	3	4

Other (Specify):

_____

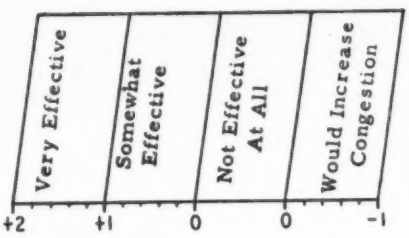
6a. **How would you or other household members feel about traveling to and from work in a car pool? ("X" ONE ONLY)**

Very interested	12.0%
Somewhat interested	34.8
Not at all interested	34.8
Already in car pool	7.6
Do not travel to and from work by car	10.8

6b. **If it became necessary to restrict the number of cars on expressways and streets in order to reduce pollution and car pools became necessary, how difficult do you think it would be to get into one an existing one or organize one amongst your friends, neighbors and/or work associates. ("X" ONE ONLY)**

Extremely difficult	19.6%
Very difficult	16.3
Somewhat difficult	38.0
Somewhat easy	6.5
Very easy	8.7
Extremely easy	4.3
Already in car pool	6.5

7. One of the major causes of areas of high pollution is traffic congestion. Pollution could be reduced if traffic congestion and stop-and-go traffic was reduced. Listed below are several ideas for reducing traffic congestion. Please tell me how effective you think each of these ideas would be in reducing congestion and pollution. ("X" ONE BOX FOR EACH IDEA)



Idea:				
a. Prohibit parking, loading and unloading on busy streets	53.8	44.2	2.2	0.0
b. Increase the number of one-way streets	17.4	48.9	27.2	6.5
c. Establish reversible lanes on busy streets to be used during rush hours	15.1	50.5	21.5	12.9
d. Prohibit turns at busy intersections during rush hours	37.6	47.3	4.3	10.8
e. Widen major streets	44.1	36.6	17.2	2.2
f. Widen major streets at intersections only	13.3	47.8	32.2	6.7
g. Provide pedestrian underpasses and/or overpasses	49.5	45.1	5.5	0.0
h. Improve timing of traffic signals	59.8	34.8	5.4	0.0
i. Increase the number and frequency of radio traffic reports	15.4	56.0	26.4	2.2
j. Turn some existing lanes into "bus only" and "car pool only" lanes on expressways and busy streets	21.3	55.3	13.8	9.6

Your ideas (Please List):

Various answers were given by respondents when they were asked to give their ideas regarding this question. Some indicated that they would like to see diesel trucks and buses as well as all old cars off the roads. Some would like to see a better mass transportation system. Others indicated they would like to see more parking lots outside of the "bad areas of pollution", as well as provision of bypasses for through traffic.

▲ - Indicates the weighted mean for each answer.

8. Since traffic congestion is most severe at times when people are going to or coming from work, one alternative for reducing congestion would be to have people start and stop work at different times of the day. That is, some people would start work at 5:00 AM and quit at 2:00 PM, others would work from 7:00 AM to 4:00 PM, others from 10:00 AM to 7:00 PM, etc. How do you feel about this idea? ("X" ONE ONLY)

Very much in favor.....	21.5%
Somewhat in favor.....	37.6
Indifferent	16.1
Somewhat opposed.....	15.1
Very much opposed.....	9.7

9a. Please record the model year of each car owned in your household. (WRITE IN BELOW UNDER 9a)

9b. Please estimate the number of miles each car was driven in the last year. (WRITE IN NUMBER OF MILES UNDER 9b BELOW)

9c. For each car, please estimate what percentage of last year's mileage was accounted for by driving outside your local metropolitan area. (For example, vacation, business trips, short weekend trips, etc.) (WRITE IN BELOW UNDER 9c)

	9a. Model Year	9b. Last Year's Mileage	9c. Percentage of Mileage Outside Local Area
Car #1	1969	11,604	30
Car #2	1967	8,622	15
Car #3	1966	6,708	4
Car #4	1965	5,500	3

9d. How many licensed drivers are there in your household? (WRITE IN)

Number of Licensed Drivers: 2.1 (Avg.)

9e. If better public transportation were available, would you consider disposing of any of the cars you own?

Yes	8.6%
Maybe	17.2
No	74.2

9f. How many? (WRITE IN) 1.0 cars

10a. Overall, how serious a problem do you think auto air pollution is in your city? ("X" ONE BOX UNDER 10a BELOW)

10b. Overall, how serious a problem do you think auto air pollution is nationwide? ("X" ONE BOX UNDER 10b BELOW)

	10a. City	10b. Nationwide
Very serious problem	12.9%	40.9%
Serious problem	32.3	44.3
Slightly serious problem...	39.7	14.8
No problem at all	15.1	0.0

11. If you have any views or comments regarding any questions or idea, please record them.

Thirty-seven respondents added comment at the end of the questionnaire. Some felt that a good public transit system would help to reduce pollution if the fares were not too high. Others felt that industry around the metropolitan area is contributing more air pollution than cars. Some added that present laws (or any future ones) should be strict and should be enforced. In general, most recognized the need for pollution control.

FIGURE

CONSUMER MAIL PANELS

323 SOUTH FRANKLIN STREET · CHICAGO, ILLINOIS 60606

(2-C796)

Dear Panel Member,

Today, I am sending you a questionnaire which I consider both exciting and interesting. Hopefully, you will too. This questionnaire deals with the important problem of air pollution caused by automobiles.

As you know, autos are a major source of air pollution—especially in metropolitan areas. You probably have read in newspapers or magazines that auto manufacturers are being required to make changes in their cars that will reduce the amount of pollutants coming out of cars. This will be particularly true for cars manufactured in 1975 and thereafter.

Many pollution experts believe, however, that despite these new federal regulations on auto air pollution, other ways will have to be found to further reduce pollution caused by cars. The purpose of this questionnaire is to obtain your reaction to these new auto pollution control ideas being suggested by the experts. In answering some questions, you will probably have to consult other members of your family to get their ideas and reactions. I am sorry if this is inconvenient, but I am sure you will agree that the importance of solving pollution problems is worth making every reasonable effort.

As always, please check each of your answers after you have completed the questionnaire. Then return it to me in the enclosed postage-paid envelope. If you have any additional comments, please write them on the lines provided in Question 11.

Cordially,

Marie

FIGURE (CONT'D.)

CONSUMER MAIL PANELS

(2-C796)

AUTO AIR POLLUTION QUESTIONNAIRE

1. All autos made in 1975 and thereafter will be equipped with emmision control devices to reduce air pollution. If in 1975 you owned a car built before that year, how would you feel about a law requiring you to put emission control equipment which might cost $200 on your car? ("X" BELOW) — 13

2. How would you feel about this law if the cost was reduced by government subsidy to about $50? ("X" BELOW) — 14-16 Open

Feeling Toward Law:	1. Cost $200	2. Cost $50
Very much in favor of law . .	☐1	☐1
Somewhat in favor of law . . .	☐2 (17)	☐2 (18)
Somewhat against law	☐3	☐3
Very much against law	☐4	☐4

3a. Even cars properly equipped with emmision control equipment might still pollute the air if the equipment was not properly maintained. How would you feel about a law requiring periodic inspection of the emission control system to assure that it was working properly? ("X" ONE ONLY) — 19

Very much in favor of law ☐1 | Somewhat in favor of law ☐2 | Somewhat against law ☐3 | Very much against law ☐4

3b. Assuming you had to have your car inspected at least once a year, what would you consider a reasonable cost for the inspection? (WRITE IN AMOUNT) — 20 ☐☐ 21

$_____

3c. Assuming you had to have your car inspected at least once a year, where do you think the inspection should be made? ("X" ONE ONLY) — 22

At state-operated inspection centers . ☐1
At city-operated inspection centers . . ☐2
At local service stations or garages . ☐3
At some other place (Specify): _____ ☐4

4a. Even if all autos were equipped with properly maintained emission control systems, some cities might still have auto air pollution problems due to the large number of cars either on the streets at the same time or concentrated in particular areas. Listed below are several possible ways to reduce pollution under one or both of these conditions. Please tell me how you feel about each of these proposals. ("X" ONE ON EACH LINE)

Proposal:	To Me This Plan Is: Very Acceptable	Somewhat Acceptable	Neither Acceptable Nor Unacceptable	Somewhat Unacceptable	Very Unacceptable	
a. Gasoline rationing	☐1	☐2	☐3	☐4	☐5	23
b. Very high ($500) registration fee per auto.	☐1	☐2	☐3	☐4	☐5	24
c. Very high ($500) registration fee per auto but only for the second, third, etc , auto.	☐1	☐2	☐3	☐4	☐5	25
d. Prohibit traffic and parking in central business districts	☐1	☐2	☐3	☐4	☐5	26
e. A tax on all day parking in central business districts . .	☐1	☐2	☐3	☐4	☐5	27
f. A tax on parking in central business districts regardless of whether a person parked only one hour or all day	☐1	☐2	☐3	☐4	☐5	28
g. Tolls on exit ramps of major freeways and expressways	☐1	☐2	☐3	☐4	☐5	29
h. Tolls on exit ramps of major freeways and expressways but only when traffic was heavy.	☐1	☐2	☐3	☐4	☐5	30
i. Restrictions on non-essential auto travel during times of high pollution by issuance of special license plates or vehicle stickers	☐1	☐2	☐3	☐4	☐5	31
j. Turn some existing lanes into "bus only" and "car pool only" lanes on major expressways and streets. . . .	☐1	☐2	☐3	☐4	☐5	32

4b. Which of the proposals listed above would be the most acceptable? (Give Letter)_____ — 33

4c. Which would be most unacceptable? . . . . . (Give Letter)_____ — 34

FIGURE (CONT'D.)

Page 7 (2-C796)

QUESTIONS 5-8 ASK FOR INFORMATION RELATING TO OTHER HOUSEHOLD MEMBERS. CONSULT THEM, IF NECESSARY, FOR THE ANSWERS.

5a. How often do the various members of your household travel by public transportation? (For example, by bus, subway, or commuter train.)

	Husband	Wife	Children (Over 16 Years Old)
Three or more times a week	...☐1	...☐1	...☐1
One or two times a week	...☐2	...☐2	...☐2
Once a month	...☐3 (35)	...☐3 (36)	...☐3 (37)
Once every three months	...☐4	...☐4	...☐4
Never	...☐5	...☐5	...☐5
No household member	...☐6	...☐6	...☐6

5b. Please rate each household member's reason for using public transportation. (Rate the most important reason "1", the next most important "2", the next "3", etc. If a household member never uses public transportation, "X" the "never use" box at the bottom of the list.)

5c. Please rate each household member's reasons for traveling by auto. Follow the same procedure as in Question 5b. (WRITE IN BELOW UNDER 5c)

Reasons	5b. Public Transportation: Husband	Wife	Children (Over 16 Years Old)	5c. Auto Transportation: Husband	Wife	Children (Over 16 Years Old)
a. Cheaper	___(38)	___(39)	___(40)	___(41)	___(42)	___(43)
b. Faster	___(44)	___(45)	___(46)	___(47)	___(48)	___(49)
c. More comfortable	___(50)	___(51)	___(52)	___(53)	___(54)	___(55)
d. Safer for passenger	___(56)	___(57)	___(58)	___(59)	___(60)	___(61)
e. Less congested	___(62)	___(63)	___(64)	___(65)	___(66)	___(67)
f. More available	___(68)	___(69)	___(70)	___(71)	___(72)	___(73)
g. More flexible (I can come and go as I please)	___(15)	___(16)	___(17)	___(18)	___(19)	___(20)
h. More relaxing (able to read while traveling)	___(21)	___(22)	___(23)	----- (Not Applicable) -----		
i. Need car during the day	----- (Not Applicable) -----			___(24)	___(25)	___(26)
j. I do not have a driver's license	___(27)	___(28)	___(29)	----- (Not Applicable) -----		
k. Car is not available when I need it	___(30)	___(31)	___(32)	----- (Not Applicable) -----		
l. Other (Specify): _____	___(33)	___(34)	___(35)	___(36)	___(37)	___(38)
m. Never use ("X" Box)	☐1	☐2	☐3 (39)	☐1	☐2	☐3 (40)

(74-78 open) 79-[1]80 Cd. 2 Dup. 1-14

5d. Again, consulting other members of your household, please rate in order of effectiveness which items below you feel would be most effective in encouraging the use of public transporation: (Rate the most effective item a "1", the next most effective "2", the next "3", etc.)

Items:	Husband	Wife	Children (Over 16 Years Old)
Cleaner and newer vehicles	___(41)	___(42)	___(43)
Faster travel	___(44)	___(45)	___(46)
Air-conditioned vehicles	___(47)	___(48)	___(49)
More frequent service	___(50)	___(51)	___(52)
Lower fares	___(53)	___(54)	___(55)
Parking facilities at stops or stations	___(56)	___(57)	___(58)
Shelters against bad weather at stops or stations	___(59)	___(60)	___(61)
Better security to assure personal safety	___(62)	___(63)	___(64)
More conveniently located stops or stations	___(65)	___(66)	___(67)
Other (Specify): _____	___(68)	___(69)	___(70)

(71-78 open) 79-[2]80

FIGURE (CONT'D.)

(2-C796) Page 3

6a. How would you or other household members feel about traveling to and from work in a car pool? ("X" ONE ONLY) Cd. 3 Dup. 1-14

- Very interested . . . . . ☐1
- Somewhat interested . . . . ☐2
- Not at all interested . . . . ☐3
- Already in car pool. . . . . ☐4
- Do not travel to and from work by car. . . . . ☐5

15

6b. If it became necessary to restrict the number of cars on expressways and streets in order to reduce pollution and car pools became necessary, how difficult do you think it would be to get into one an existing one or organize one amongst your friends, neighbors and/or work associates. ("X" ONE ONLY)

- Extremely difficult . . . . ☐1
- Very difficult . . . . . ☐2
- Somewhat difficult . . . . . ☐3
- Somewhat easy . . . . . ☐4
- Very easy. . . . . ☐5
- Extremely easy . . . . . ☐6
- Already in car pool . . . . ☐7

16

7. One of the major causes of areas of high pollution is traffic congestion. Pollution could be reduced if traffic congestion and stop-and-go traffic was reduced. Listed below are several ideas for reducing traffic congestion. Please tell me how effective you think each of these ideas would be in reducing congestion and pollution. ("X" ONE BOX FOR EACH IDEA)

Idea	Very Effective	Somewhat Effective	Not Effective At All	Would Increase Congestion	
a. Prohibit parking, loading and unloading on busy streets	☐1	☐2	☐3	☐4	17
b. Increase the number of one-way streets.	☐1	☐2	☐3	☐4	18
c. Establish reversible lanes on busy streets to be used during rush hours.	☐1	☐2	☐3	☐4	19
d. Prohibit turns at busy intersections during rush hours .	☐1	☐2	☐3	☐4	20
e. Widen major streets.	☐1	☐2	☐3	☐4	21
f. Widen major streets at intersections only.	☐1	☐2	☐3	☐4	22
g. Provide pedestrian underpasses and/or overpasses . . .	☐1	☐2	☐3	☐4	23
h. Improve timing of traffic signals.	☐1	☐2	☐3	☐4	24
i. Increase the number and frequency of radio traffic reports	☐1	☐2	☐3	☐4	25
j. Turn some existing lanes into "bus only" and "car pool only" lanes on expressways and busy streets	☐1	☐2	☐3	☐4	26
Your ideas (Please List): _____	☐1	☐2	☐3	☐4	27

8. Since traffic congestion is most severe at times when people are going to or coming from work, one alternative for reducing congestion would be to have people start and stop work at different times of the day. That is, some people would start work at 5:00 AM and quit at 2:00 PM, others would work from 7:00 AM to 4:00 PM, others from 10:00 AM to 7:00 PM, etc. How do you feel about this idea? ("X" ONE ONLY)

- Very much in favor . . . . . ☐1
- Somewhat in favor . . . . . ☐2
- Indifferent. . . . . ☐3
- Somewhat opposed . . . . . ☐4
- Very much opposed . . . . . ☐5

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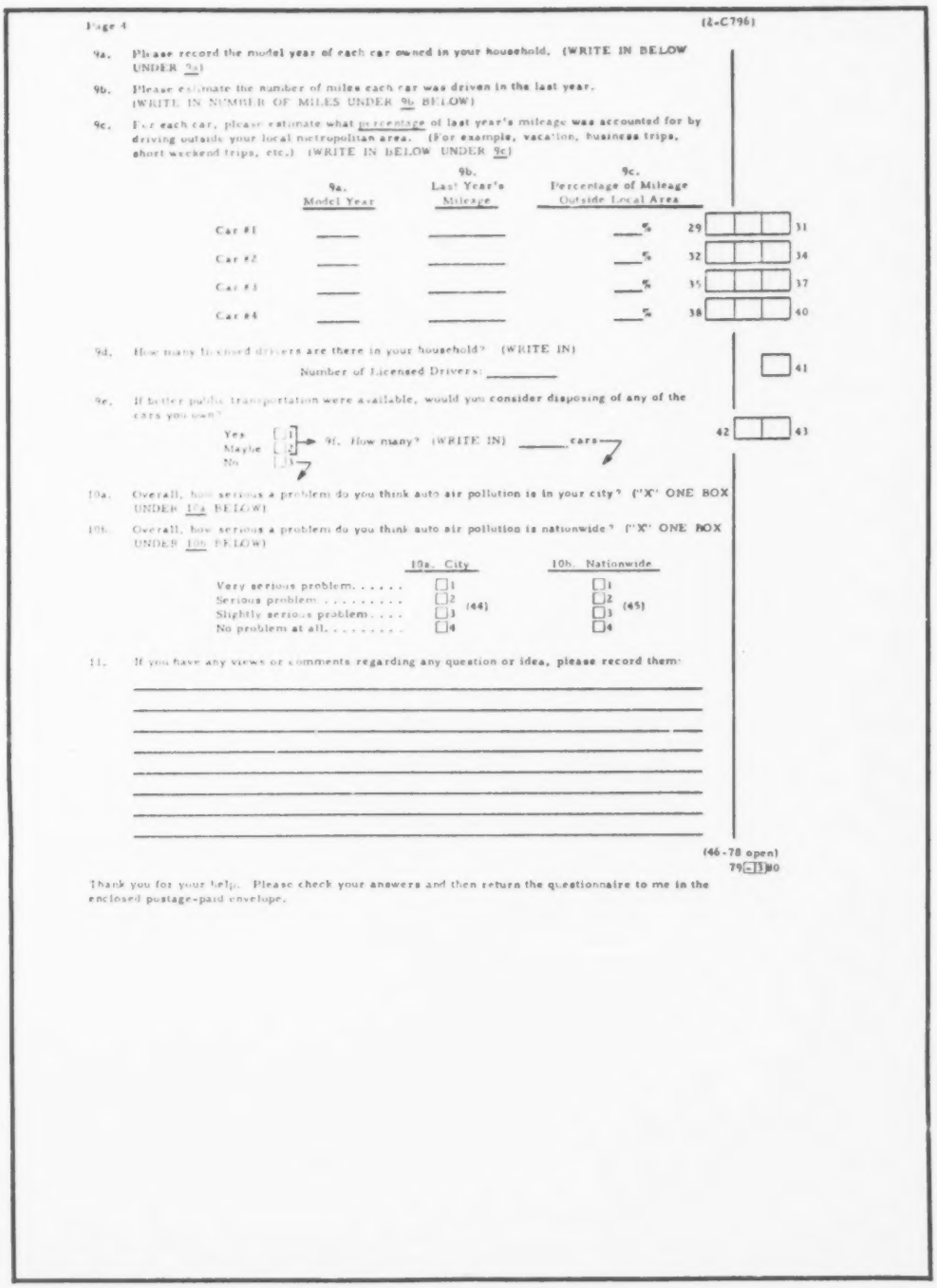
(PLEASE CONTINUE ON THE NEXT PAGE)

FIGURE



Page 4 (2-C796)

9a. Please record the model year of each car owned in your household. (WRITE IN BELOW UNDER 9a)

9b. Please estimate the number of miles each car was driven in the last year. (WRITE IN NUMBER OF MILES UNDER 9b BELOW)

9c. For each car, please estimate what percentage of last year's mileage was accounted for by driving outside your local metropolitan area. (For example, vacation, business trips, short weekend trips, etc.) (WRITE IN BELOW UNDER 9c)

	9a. Model Year	9b. Last Year's Mileage	9c. Percentage of Mileage Outside Local Area	
Car #1	____	_____	___%	29 ☐☐☐ 31
Car #2	____	_____	___%	32 ☐☐☐ 34
Car #3	____	_____	___%	35 ☐☐☐ 37
Car #4	____	_____	___%	38 ☐☐☐ 40

9d. How many licensed drivers are there in your household? (WRITE IN)

Number of Licensed Drivers: _____ ☐ 41

9e. If better public transportation were available, would you consider disposing of any of the cars you own?

Yes ☐1 → 9f. How many? (WRITE IN) _____ cars
Maybe ☐2
No ☐3

42 ☐☐ 43

10a. Overall, how serious a problem do you think auto air pollution is in your city? ("X" ONE BOX UNDER 10a BELOW)

10b. Overall, how serious a problem do you think auto air pollution is nationwide? ("X" ONE BOX UNDER 10b BELOW)

	10a. City	10b. Nationwide
Very serious problem.	☐1	☐1
Serious problem.	☐2 (44)	☐2 (45)
Slightly serious problem. . . .	☐3	☐3
No problem at all.	☐4	☐4

11. If you have any views or comments regarding any question or idea, please record them:

_____
_____
_____
_____
_____
_____
_____
_____

(46-78 open)
79-80

Thank you for your help. Please check your answers and then return the questionnaire to me in the enclosed postage-paid envelope.